Claims

1. A method of seismic exploration which comprises: generating a seismic event; applying the seismic event to the earth's surface (13); detecting a response to the event, the detected response including P-waves and S-waves in the earth's surface (13); and analysing the detected response; and in which: the detecting step comprises monitoring and recording the response to the seismic event in the form of movements of particles at the earth's surface (13), from a position spaced from the earth's surface (13), the detecting step being carried out over a response period, the response period being a predetermined period of time after the seismic event; and the analysing step comprises analysing the movements of particles at the earth's surface (13) in the recorded response to the seismic event during the response period.

2. A method as claimed in Claim 1, in which the movements of the particles are monitored using light, in the form of visible light, x-rays, UV light or IR light, or using another form of radiation including radio waves, radar, sonar or using acoustic waves.

3. A method as claimed in Claim 1 or Claim 2, in which the monitoring is carried out using monitoring apparatus (14) which is moved relative to the earth's surface (13) during the response period.

4. A method as claimed in Claim 3, in which the analysing step includes the elimination from the detected response of noise caused by the relative movement of the monitoring apparatus.

5. A method as claimed in Claim 1 or Claim 2, in which the monitoring is carried out using monitoring apparatus (32) which is kept stationary during the

response period and is then moved to a different position after the response period, and the method is then repeated.

6. A method as claimed in any of Claims 3 to 5, in which the monitoring apparatus comprises several monitoring devices (14) which are used simultaneously at different locations.

7. A method as claimed in any preceding Claim, in which the response is transformed to and recorded in digital form.

8. A method as claimed in any preceding Claim, in which the analysing step comprises analysing surface particle displacements and/or velocities and/or accelerations.

9. A method as claimed in any of Claims 2 to 8, in which the monitoring apparatus comprises three sources of coherent mono frequency light directed at the surface area being monitored, and a receiver for reflected coherent light, or a single source of coherent light and three receivers.

10. A method as claimed in Claim 9, in which the coherent light and a reference beam are used to make speckle patterns by means of interferometry, and changes in the speckle patterns are analysed in the analysing step.

11. A method as claimed in any of Claims 2 to 8, in which the monitoring apparatus (14) comprises video recording apparatus.

12. A method as claimed in Claim 11, in which the video recording apparatus includes one or more cameras operating on the basis of visible light.

13. A method of marine seismic exploration, as claimed in any preceding Claim, and in which the earth's surface is the sea bed (13), the seismic event is applied to the sea or directly to the sea bed and the monitoring apparatus (14) is spaced above the sea bed.

14. A method as claimed in Claim 13, in which the monitoring apparatus is located from 0.5 to 5 metres above the sea floor during the response period.

15. A method as claimed in Claim 13 or Claim 14, in which the monitoring apparatus (14) additionally comprises a hydrophone.

16. A method as claimed in any of Claims 13 to 15, in which the monitoring apparatus is either towed or is self-propelled and the analysing step includes the elimination from the detected response of noise representing disturbances caused by the motion of the monitoring apparatus.

17. A method as claimed in any of Claims 13 to 16, in which the particles whose movements are detected are sand particles on the sea floor (13).

18. A method as claimed in any of Claims 13 to 17 in which the seismic event comprises a seismic wave having a wavelength in the range 5 to 100 m and a duration of up to 3s.

19. A method as claimed in any of Claims 13 to 18 in which the response period is from 4 to 8 seconds.

20. A method as claimed in any of Claims 13 to 19, in which the monitoring apparatus comprises a plurality of monitoring devices (22) mounted on a plurality of cables, the monitoring devices on each cable being spaced from

each other by a distance which is less than the wavelength of the transmitted seismic event.

21. Apparatus for carrying out seismic exploration which comprises: means for generating a seismic event (12); means for applying the seismic event to the earth's surface; detecting apparatus (14) for detecting a response to the event including P-waves and S-waves in the earth's surface (13); and means for analysing the detected response; and in which: the detecting apparatus (14) comprises monitoring apparatus and recording apparatus arranged to monitor and record the response to the seismic event in the form of movements of particles at the earth's surface (13), from a position spaced from the earth's surface (13), over a predetermined response period after the seismic event.

22. Apparatus as claimed in Claim 21, in which the monitoring apparatus (14) uses light, in the form of visible light, x-rays, UV light or iv light or uses another form of radiation including radio waves, radar, sonar or uses acoustic waves.

23. Apparatus as claimed in any of Claims 21 to Claim 23, in which the monitoring apparatus (14) is movable relative to the earth's surface during the response period.

24. Apparatus as claimed in Claim 21 or Claim 22, in which the monitoring apparatus (14) is capable of being kept stationary during the response period and then moved to a different position after the response period.

25. Apparatus as claimed in any of Claims 21 to Claim 24, in which the monitoring apparatus comprises several monitoring devices (22) which are used simultaneously at different locations.

26. Apparatus as claimed in any of Claims 21 to 25, in which the monitoring apparatus (14) comprises three sources of coherent light arranged to be directed at the area being monitored, and a receiver for reflected coherent light.

27. Apparatus as claimed in any of Claims 21 to 25, in which the monitoring apparatus (14) comprises video recording apparatus and the recorded response is a visual record.

28. Apparatus for marine seismic exploration, as claimed in any of Claims 21 to 27, and in which: the earth's surface is the sea bed (13), the seismic event is arranged to be applied to the sea or directly to the sea bed and the monitoring apparatus (14)is arranged to be spaced above the sea bed (13).

29. Apparatus as claimed in Claim 28, in which the detecting apparatus additionally comprises a hydrophone.

30. Apparatus as claimed in Claim 28 or Claim 29, in which the detecting apparatus is either arranged to be towed by a vessel or is self-propelled.

31. Apparatus as claimed in any of Claims 21 to 30, in which the detecting apparatus comprises a plurality of monitoring devices (22) mounted on a plurality of cables, the monitoring devices on each cable being spaced from each other by a distance which is less than the wavelength of the transmitted seismic event.

32. A method of producing a seismic survey report of a region, which comprises: carrying out a method as claimed in any of Claims 1 to 20; deriving

from the analysing step, representations of subsurface layers; and assembling the representatives as a depiction of the geological structure of the region.